DESIGN FOR SUSTAINABILITY APPLIED TO WORKSPACES

Susana Soto Bustamante
Elena Elgani
Francesco Scullica

ABSTRACT

Due to the behavioral changes of society in a dynamic and interconnected world, workspaces have gotten a new meaning. Designers must understand the needs and desires of the final users in order to create something that fulfills them and creates a whole experience out of it. By adopting living systems "ecological" worldview, design will require a higher level of interrelationships between natural, human and built systems, and the disciplines within them (Boecher et al, 2009, p xii) describe the achievement of a broader integration of systems within the sustainability movement as an "Integrative Design Process (IPD)".

The aim of this paper is to comprehend how Product-Service System Design methodologies can be applied in Interior Design with the means of designing a workspace that by being co-created by the users, can become more sustainable and that can satisfy better the end user. Besides, the relation of Interior Design and Sustainability, that comes after the comprehension of it in two levels. The first one is a social level, associated to the well-being of the end user in a workspace (lighting, insulation and many other specs of the spaces), while the second level is the study of the environmental design of the spaces (materials & products) supported by Life Cycle Assessments (LCA) studies, to cognize about the carbon footprint left in the world through all the life cycle phases. These different studies become crucial on the decision making, since they can change the perception we have about materials or furniture chosen within a project.

Finally, with means of supporting the ideas exposed and to have a better understanding of it, we expose some case studies. The aforementioned research is part of the outcome of an ongoing thesis held for a Master of PSSD at the Design Department of Politecnico di Milano and part of the Farb Research (ISBN: 9788891777201).

Keywords: Product-ServiceSystems, Interior Design, Sustainability, Co-Design

1. EVOLUTION OF WORKSPACES & NEW TRENDS

The growth of the world population and the increase of inhabitants in urban settlements, together with the constant technological developments, impose a continuous rethinking of ways and places in which we live (Heidegger, 1954). It is estimated that by 2050 the earth will reach 10 billion inhabitants, from which 66% of the world population will live in megapolis and large cities[1].

Over time, living has increasingly become a more composite and multifaceted, both in relation to the numerous declinations of individuality and with respect to technological developments and socio-economic changes, because "the environment that surrounds us is a dynamic intersection of fast and complex social, cultural and environmental entities" (Sayegh, 2018, p.9). In addition, the fast development of many typologies of spaces as a result of the transformation of the activities performed inside them, the experience of motion, and the technological advances in transports, has led to the possibility of traveling to an increasing number of individuals. (Scullica, 2018).

The sociologists John Urryand Mimi Sheller, who have long studied the mobility of individuals, stated that:

"all the world seems to be on the move. Asylum seekers, international students, terrorists, members of diasporas, holidaymakers, business people, sports stars, refugees, backpackers, commuters, the early retired, young mobile professionals, prostitutes, armed forces -these and many others fill the world's airports, buses, ships, and trains. The scale of this travelling is immense. Internationally there are over 700 million legal passenger arrivals each year" (Urry and Sheller, 2006, p.207).

According to the sociologist Urry and Elliott (Elliott, Urry, 2010) mobile life, is changing the behavior of societies, from the way in which people think and interact to the physical space and connections in which they live. These factors are now an essential condition -in particular interiors -and they must be considered.

During the '90s the home office phenomenon started due to the possibility of working home by the new computer technologies. Since then, communication technologies have increased and evolved in a way that nowadays work can be easily carried out everywhere, and it is above all connected with the new spaces for "living, working and travelling", leading to the new working model, smart working[2]. (Scullica, Elgani, 2018)

"Nowadays, offices are no longer just a system of workstations -they are slowly transformed to match with new lifestyles" [3](Berberi, 2017). Mobility has become an existential dimension based on eradication, related to one's personal identity, relations in between a community in which it is not linked a physical space nor a given time.

In a global dimension where individuality and isolation prevail, many people share the need to be part of a "light community", based on lifestyles, tastes and similar interests (Manzini, 2018), in which distinct solitudes can be connected to each other by sharing a sensory experience.

Workspaces have evolved in a dramatic way on the past decades due to many changes of the behavior of society and in the whole working system. Likewise, internet has brought people closer by being virtually connected. Nowadays, there is no need to have physical contact to share information or knowledge, this leads to the rise of "working nomads" or "knowledge workers", who can be defined as people that work independently in different locations and that thanks to the internet access, smartphones and voice over internet protocol (VoIP) are able to keep contact with clients and employers all over the world, no matter the location.

The rise of rent prices and real estate is making rethink and reorganize the distribution and working areas inside companies. Due to this fact, and thanks to the IoTs that allow people to continue to be connected even from far away, corporations are applying different working systems to have less people inside the working space. Some of these methodologies are to reduce the number of square meters by outsourcing services, using teleworking systems for fixed workers or even using a hot-desking concept inside the workplace.

In addition, the high costs for companies in terms of salaries, taxation systems and workspaces has brought to the demand of outsourcing system services instead of hiring people for fixed-job positions. Thus, the market of freelancers or knowledge workers is increasing in the population -and in response, the rising demand of coworking spaces.

Furthermore, most of knowledge workers who used to have their own space are not able to pay the high rents of private offices anymore. This has led to the demand of spaces capable to suit multi-functions that can easily adapt to different situations and to shared spaces by workers of different fields who are able to share knowledge and build new networks.

Communication through the network has become a central and fundamental element in the work field: in first place, as cause of the IoTs the exchange of information between individuals has increased in a level that it has brought new varieties of collaborations and relationship in informal and formal ways. The comprehension between people, spaces and objects is possible because environments has become progressively smart and able to interact with individuals (Elgani, 2018).

[1] retrieved from www.esa.un.org/unpd/wpp/

[2] The Italian law n. 81 of 22 May 2017 defines by rule Smart Working -a management model that allows people to work from a distance and increases worker's freedom and autonomy. In Italy this phenomenon is monitored by the Smart Working Observatory of the School of Management of the Politecnico di Milan

[3] Berberi L. "Benvenuti nella casa-ufficio di Milano, gli studi del Politecnico per ripensare il posto di lavoro: diventera uno spazio ibrido tra dovere, riposo e piacere", in Corriere della Sera, 3rd April 2017.

The way in which work is conceived and organized has been radically transformed, even before the physical workspaces. In order to achieve a shared goal, there is the wish to create "community" -a word that the Italian entrepreneur Adriano Olivetti had strongly connected to the work field (Olivetti, 2013) -because of the current need to share complex processes among professionals with different skills. Meanwhile, the users need individual workspaces where they can have privacy and silence to achieve more productivity or concentration.

Flexibility, creativity, speed and adaptation become essential requirements for the nowadays workers. They must learn to relate with increasingly sophisticated tools and machines.

As written by Michele De Lucchi in Domus[4], from an architectural point of view we witness a dematerialization of the workspaces because at present many professionals can easily work from home or from public spaces, like a bar and a restaurant, or while travelling from a place to another by simply having access to a device with internet connection.

Technological and design evolution have allowed the creation of complex devices that are small and easily transportable, and integrated systems for spaces and furnishings that are increasingly capable of relate with the users. Presently, it is possible to organize meetings in real time with people located in different parts of the globe, without the need to meet physically; Pajevicand Shearmur define this phenomenon as "workplace mobility «with reference to "the ability of workers to carry out work-related activities at any time and at any place as a result of the computerization of work-related activities, workplace technology miniaturization, and IoTs" (Pajevic, Shearmur, 2017).

For the previous exposed, we can conclude that social behaviors and the evolution in technologies -between other facts -have led to an extreme change in the working environment. Companies have less fixed workers but focus more on supporting them with an environment that looks after their human needs, taking in count not just the physical space but supporting their health in a holistic way. On the other side, knowledge workers are in continuous search for places where to develop their activities and build new networks, thus, the appearance of coworking spaces and hubs focus on bringing to their users 'spaces and commodities user-based.

Workspaces -both for smart workers or fixed workers -are mainly places that are currently following sustainable trends in two senses. The first one, is to choose the right materials, furniture and to add the technical solutions to achieve a sustainable environment. The second one, is to achieve sustainability by understanding the ongoing social behaviors to support the wellbeing of the users, achieving a nature minded mindset.

In order to achieve sustainable spaces, designers need to understand the meaning of environmental spaces, for creating afterwards hybrid spaces where smart and modular furniture can adapt to changing situations within some quick changes while maintaining the existence of private spaces, intermediate spaces and public spaces -in which sometimes can be included "hot-desking areas"-. Another topic is to understand the needs and desires of the users to create user-based service-systems that supports the wellbeing of them while allowing the progress of their professional activities.

2. PRODUCT SERVICE SYSTEM DESIGN & CO-CREATION

Due to the societal lifestyle shifts, priorities of the users have changed from owning to experiencing, this means that people are not looking after the sense of belonging goods anymore but the sense of being fulfilled by having the best experience out of something. Therefore, Product-Service System Design (PSSD) is increasingly getting more importance in the design world.

PSSD consists on a mix of tangible products and services designed and combined so that they jointly are capable of fulfilling final customer needs (A. Tukker, U. Tischner, 2006). Product-Service Systems are a specific type of value proposition that a business (network) offers to (or co-produces) with its clients which end up being the final users (Tukker, Tischner, 2006). Having as an outcome user-based PSS.

The evolution in design research from a user-centered approach to co-designing is changing the roles of the designer, the researcher and the person formerly known as the 'user'. The implications of this, shift for the education of designers and researchers are enormous. The evolution in design research from a user-centered approach to co-designing is changing the landscape of design practice as well, creating new domains of collective creativity. i.e. creativity that is shared by two or more people. (Sanders, Stappers, 2008), thus, co-design is a specific instance of co-creation, referring to experienced designers and inexpert people working together through the development of the design process to achieve a holistic system where tangibles and intangibles -together -fulfil of the needs and desires of the users.

Before the decade of '70s designers took practice of human centered design (fig.1), using people as the center of the study and exploring their needs and desires. On the other hand, with the evolution and further studies of the design practices, it has been proved that it is more efficient to involve the final users as stakeholders into the design process in order to have a better outcome. Therefore, co-design gets the roles mixed up (fig.2), positioning the person who will use the product or service as an expert through the design process, playing a main role in the design process and idea generation. Instead, the designer plays the role of researcher, collaborating and using different tools through the process of idea generation.

[4] "On my travels around the world, coffee chains are my favorite offices: Pret a Manger, Starbucks… I can have breakfast, lunch and dinner, sitting all the day with Wi-Fi and aroma of bread and croissants in the air. I can look around and be surprised by people's different habits, and I can invite people and easily organize my meetings. Sure, personality is lacking, but no one interrupts me and the efficiency is first class." De Lucchi M., "With the artificial intelligence, offices are becoming places of ideas" in Domus n.1022 March 2018, p. 34.

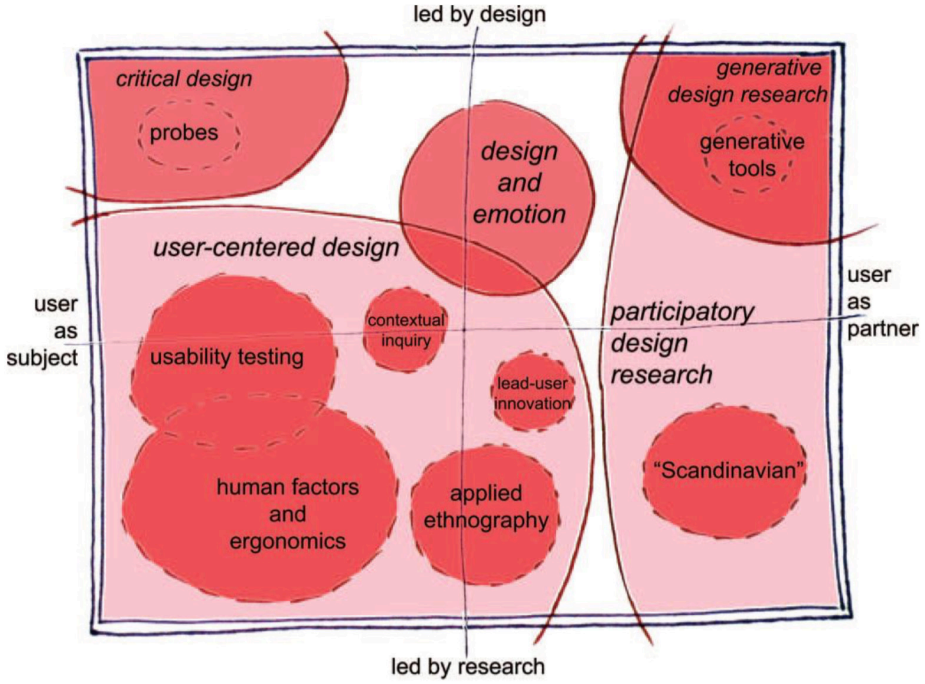


Fig 1.-The current landscape of human-centered design research as practiced in the design and development of products and services. E.B. -N Sanders and P.J. Stappers, 2008

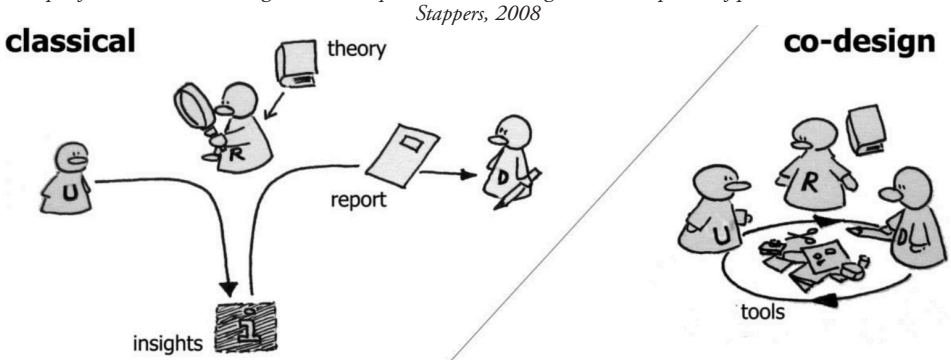


Fig 2.-Classical roles of users, researchers and designers in the design process (on the left) and how they are merging in co-designing process (on the right) -Graphic by Sanders and Stappers, 2008

According to Sanders and Stappers, even though co-design and co-creation are terms that are being used just during the past years, the practice of collective creativity has been used for around 40 years under the term "participatory design". This was used mainly in Nordic countries and used to increase the value of industrial production by engaging the users in the development of the systems for the workplaces. The approach, thus, built on the workers' own experiences and provided them with the resources to be able to act in their current situation (Bodker, 1996).

Co-creation practiced on an early stage of the design process tends to have a positive impact with long-range consequences, however, participatory design is getting importance in the interior design of workspaces. The decisions and outcomes created in this stage may vary, but they are helping to reconfigure the way of interior design in a more holistic way by understanding humans in the most basic level. (Institute of Noetic Sciences, 2007)

Techniques used for the concept development such as co-creation and co-design, explain how they work and how this helps designers to have a most accurate -and efficient -design, merging tangibles and intangibles, which ideally become more sustainable.

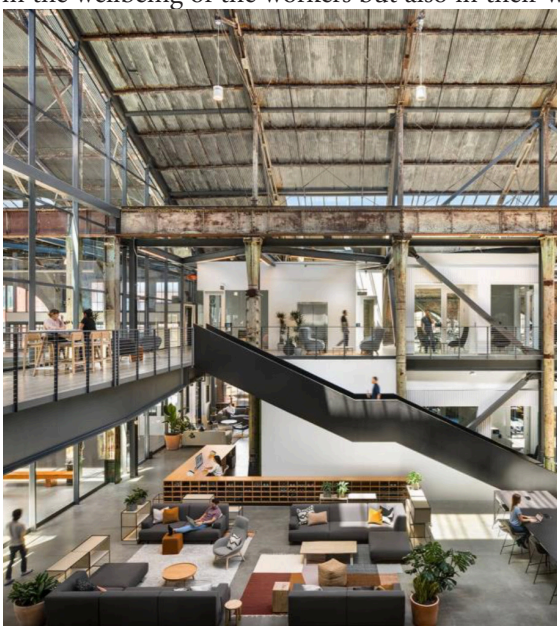
Co-designing require creative initiative on the part of the entire team: researchers, designers, clients and the people who will ultimately benefit from the co-designing experience (Sanders and Stappers, 2008). We are not only designing interiors, but furthermore, experiences for interconnected societies. We are moving from the design of categories of "Products" to designing people's purposes -from space design to emotion design, from architecture to serving, from planning to transforming -where the designer gains the skills needed to expertly conceive and give shape to products such as brand identities, interior spaces, buildings, etc. (Sanders, Stappers, 2008).

2.1 Case Study – Gusto by Gensler – San Francisco, CA [5]

Apple Park employees were said to be 'in revolt' over Norman Foster's valley of a plan in their new headquarters. Gensler saw in this as an opportunity to draw a flexible line: in order to make working styles as democratic as possible, instead of equalizing they decided to respect the preferred layout of each team member. During the design process, workshops and questionnaires were filled by each of the 500 employees where they could choose from a variety of spaces, both open and enclosed, public or private, to accommodate their focus styles. Therefore, co-creating the spaces as the end users desired them and following the linings and forms of the company.

[5] (data retrieved from:https://www.frameweb.com/news/gensler-gusto-headquarters; www.gensler.com).

They involved in a HR services company to -by the development of several workshops -understand the main transformation to be integrated into its human resources and to create a menu of furniture and finishes (FF&E) to define the look and feel of the new space. They created an opening day tour using VR tech allowing their employees understand how would spaces look like. This process not only helped Gusto workers and Gensler designers to have a complete user-based outcome but gave the employees a sense of ownership and compromise them with the brand, bringing positive results not only in the wellbeing of the workers but also in their working development.



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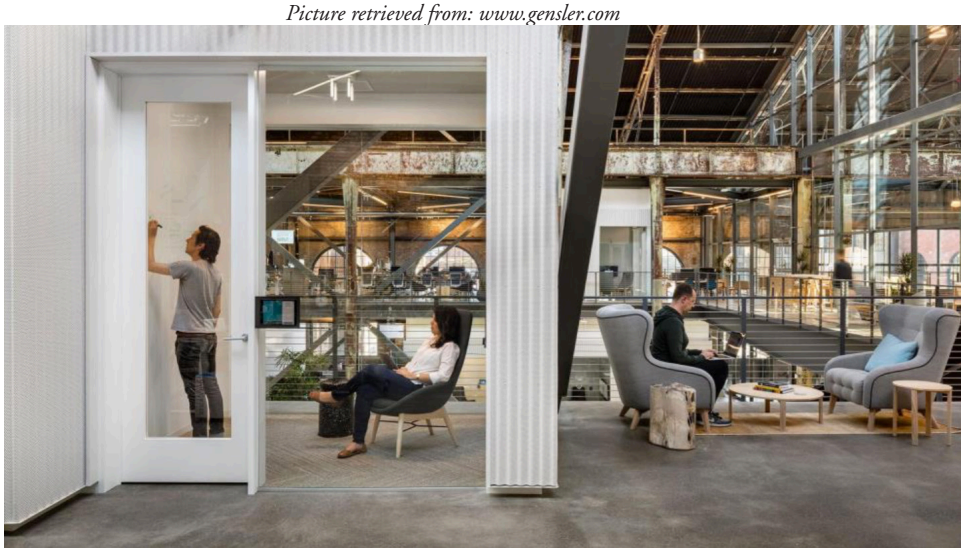

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3. WORKSPACES & SUSTAINABILITY

The way of designing workspaces needs to have a drastic change from the way it was practiced in the beginning of time. Aforetime, the purpose of working places was entirely functional, subsequently people wanted places with an aesthetical value, reason why interior designers had to work harder to please their clients. Later, ergonomics and hi-tech came into the scene, challenging designers in another level at the time of designing them.

"The environmental issue, understood as the impact of the production-consumption system on ecological equilibrium, began to be raised on the second half of the 1960's, as a consequence of the accelerating and spreading industrialization" (Vezzoli, Kothala, Srinivasan, 2014)

Due to the consumerism and abuse of resources in which the world has been living in the past decades, there is now a lack of resources. This evidence has brought new generations to the demand of new practices, where sustainability and "echo-building" prevail in the scene. Thus, interior designers have a big role since they can create a big impact on the environment by designing in a sustainable way and by choosing the right finishings, products and furniture used in a workspace understood within all the life stages of the product.

According to the book of Product Service-System Design for Sustainability (Vezzoli, Kothala, Srinivasan, 2014), there are different practices in design to reduce or eliminate the negative impact in the environment by the comprehension of the life cycles applied to interiors. Sustainable design needs to be practiced on many dimensions

(fig. 3), such as environmental, economic and socio-ethical, looking after the wellbeing of the users and the equity of resources on society. (Vezzoli, Kothala, Srinivasa, 2014).

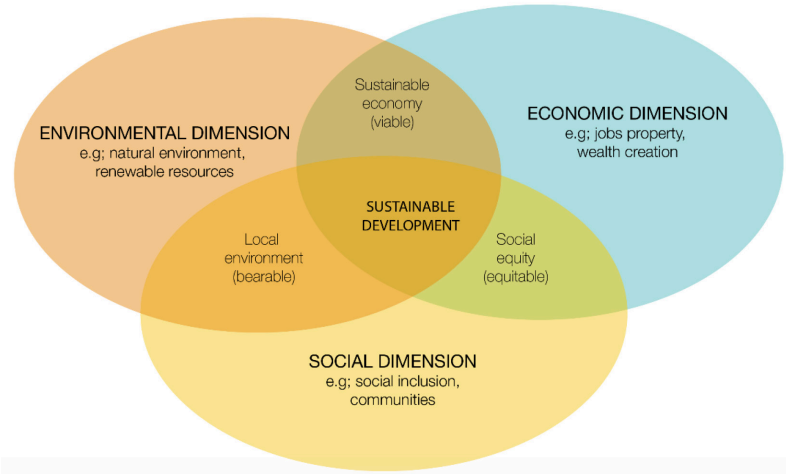


Fig 3.-Dimensions of sustainability

There are many theories and researches about the selection of materials and energy resources with low environmental impact through the different life cycle stages of a product. Topics as selection of toxic and harmful materials, recyclability and incineration, taking in account that design for recycling and reuse must cover all the life stages (Fig. 4) (collection, transportation, disassembly, cleaning, identification and production of secondary raw materials and identifying the opportunities for the re-application).

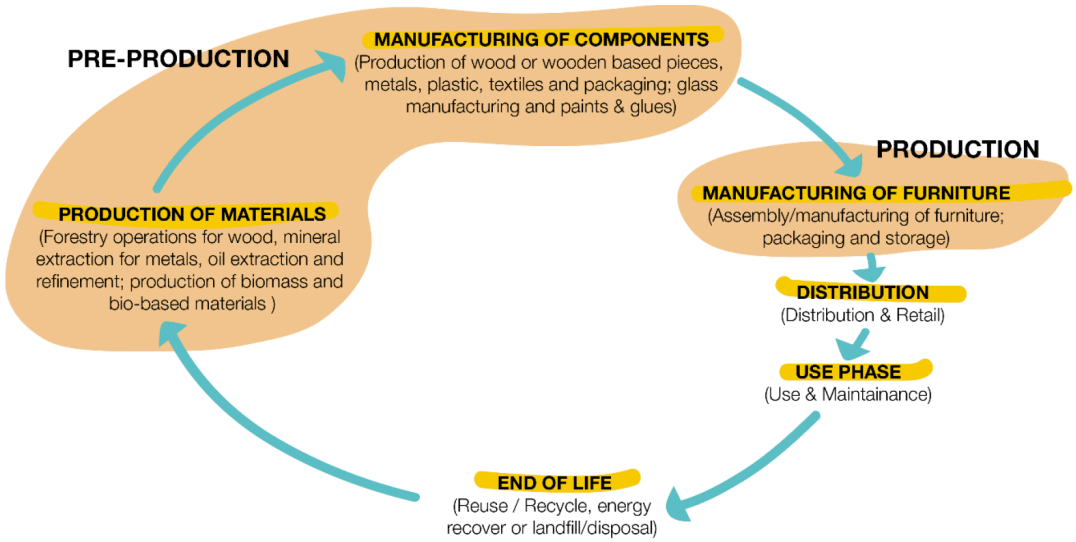


Fig.-4 -Life Cycle Stages of a Product

One ongoing debate intersubjective of biodegradability: an environmental quality that has raised many misinterpretations. It is important for materials to be re-integrable with ecosystems. Many biodegradable materials may pose a problem in the sense of a premature expiration date; this in turn creates new production and distribution processes for both substituting and discarding reasons. (Vezzoli, Kothala, Srinivasan, 2014)

In order to create an eco-efficient system, there exist different design criteria 'sand guidelines to be practiced where the optimization of resources, the efficiency of distribution, the waste minimization and the toxicity reduction can bring the whole system to have a lower impact and in the same time to be more efficient comprehending the different environmental dimensions

Thus, when designing a workspace, it is necessary to understand the impact that a product or a whole workspace carries by the comprehension of the LCA through all its phases. To take the right and conscious decisions at the time of selecting the pieces, being aware of the impact created through all the life of the products while understanding how these can be optimized, especially during the use phase and end of life phase -since are the ones that concern more to the workspace, and therefore to the end users -.

Some efficient practices are by using service-systems to prolong the life phase, where repairing, adapting and relocating furniture helps to decrease the impact by boosting the life of a product or efficiently re-inserting it by re-using pieces to create a new one.

3.1 Case Study – The Edge by Deloitte – Amsterdam, Nl

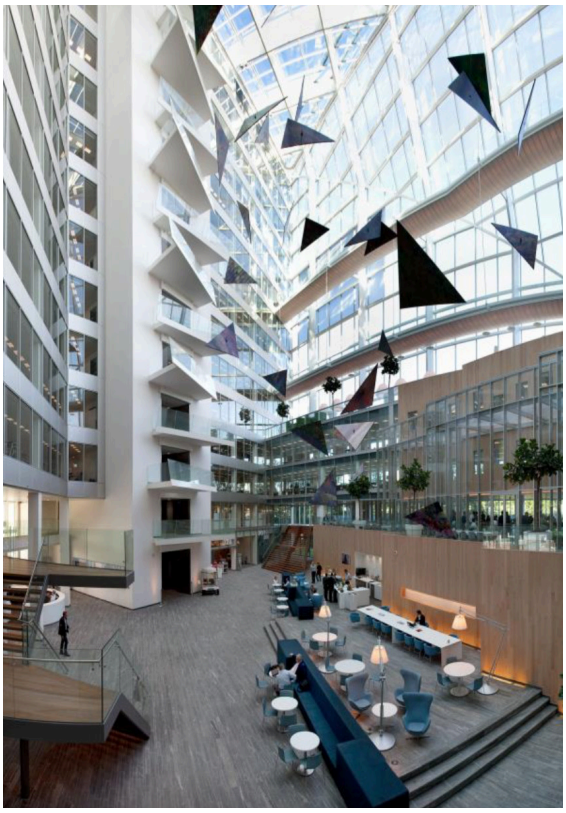
The Edge is a Deloitte Building located in Amsterdam that that opened its doors on 2015. It is promoted as" the greenest & most intelligent building in the world" (the British rating agency BREEAM, gave it the highest sustainability score ever awarded: 98.4 p%). They use service-system with the help of IoTs to shape the way the

user works, personalizing the needs and preferences of lighting, temperature control and space management. Smartphones rule this place, everything works through an app that lets the workers find colleagues, adjust the heating of their workstation and manage their daily routines.

Approaching the environmental perspective, the energy building resources come from solar panels which create more electricity than the actual consumption of the building. About 2500 workers share 1000 desks, using the "hot desking" concept with the goal of encouraging human interaction between the workers. Besides it hosts cafes, exhibition area and conference rooms. Work, space is more focused on the tasks that need to be done and the community that can be created in between the workers.

Ron Bakker, architect of the Edge at London-based PLP Architecture. "We're starting to notice that office space is not so much about the workspace itself; it's really about making a working community, and for people to have a place that they want to come to, where ideas are nurtured, and the future is determined."

Deloittesproposal, is a good practice worth to follow since from all the dimensions of environmental consciousness. It does not only approach sustainability on the environmental dimension, but also on the socio-ethical dimension, since they look after the wellbeing of the users by personalizing the preferences and needs of each of the user with the service system run by an internal app where everyone can personalize the space to be used according to their needs. Besides, thanks to the solar panel system used, the savings in energy are worth the investment that the company did.



[Figure 5,6] Photo by Raimond Wouda

4. ENVIRONMENTAL IMPACT APPLIED TO WORKSPACES

Due to the environmental effects caused by consumerism and the excess of industry production, use and disposal, during the '90s the attention moved to the environmental impact through a products life cycle (Keoleian and Menerey 1993; Brezet and Hemel 1997; Manzini and Vezzoli 1998; Tischner et al. 2000; Hemel 2001; Heiskanen 2002; Ryan 2003; Sun et al. 2003; ISO 14062 2002; Nes and Cramer, 2006).

In order to understand sustainability and its implications, it is needed to understand three interlinked dimensions, the first one is the environmental dimension, where the main task is to produce without degrading the world and its resources. The second one is a socio-ethical dimension, referred to the equal redistribution of the natural resources -based on the ideology that everyone has the same access to global natural resources -. Finally, the economic dimension, understood as economical practicable solutions in a more or less norm-oriented market.

New methodologies of assessing the environmental impact of products were developed, from them, the most accepted is the Life Cycle Assessment (LCA). The most important approaches worth to mention were:

- The concept of the life cycle approach -to design and understand all the life cycle stages -activities needed to produce the materials, parts, etc.-of a product, ways of distribution until the disposal of it.
- The functional approach -the evaluation of product environmental sustainability, beginning from its function rather than the physical embodiment of the product itself.

As exposed before, due to the radical changes held in the behaviors and the consumption of societies, the attention moved to design for eco efficient Product-Service Systems where "the result of an innovative strategy that shifts the center of business from the design and sale of(physical) products alone, to the offer of product and service systems that are together able to satisfy a particular demand" (UNEP, 2002). Therefore, the design conceptualization process needs to be expanded from a purely functional approach to a satisfaction approach, to have as an outcome a wider service-system that fulfills the demands, needs and desires of the final user-.(Vezzoli, 2003a)

5. HOW CAN WORKSPACES BE MERGED WITH PSSD METHODOLOGIES?

As exposed before, PSSD looks after sustainable products or services based in a deep research user-based through different methodologies used in the research phase. But what if the product became the place where people walks in, interacts, lives and work? That is the case with interior design and therefore, to workspaces. All the spaces we enter and interact, work and spend our daily life affect our piques, feelings and more, therefore, it is very important to consider the interaction that the user will have with the workspace at the time of designing it.

Within this framework, the discipline of Design for Sustainability has emerged, which in its broadest and most inclusive meaning could be defined as: "a design practice, education and research that, in one way or another contributes to sustainable development"5

5Some authors adopt a more stringent definition of Design for Sustainability: e.g. Tischner (2010) argues that Design for Sustainability requires generating solutions that are equally beneficial to the society and communities around us (especially unprivileged and disadvantaged populations), to the natural environment, and to economic systems (globally but especially locally).

Product-service systems can be applied into workspaces by being approached through different aspects of sustainability. The first one, approaching the socio-ethical dimension, designers can work as moderators and leaders of workshops in the early stages of the design process to understand the users in a higher level by co-designing with them, letting them to be the co-creators of the space and services that they will use afterwards, therefore the workspace outcome will adapt better to the needs and desires of the workers and in parallel the links to the traditional or non-traditional working space will be stronger .

On a later stage, approaching the environmental dimension, the comprehension and the efficient designation of materials, finishings and furniture that are included inside the workspace are fundamental to make the place have a lower impact into the environment. In these stages it is fundamental to cognize the life cycle assessments of the whole workspace through the different life stages, being conscious not just of the production or pre-production of a material but also of the end of life of the product and how this can be reused or recycled.

Finally, on the economical dimension, the creation of product-service systems can lead to a more conscious design by creating systems that may not only include interiors but entire PSS that let workspaces be more efficient and cover the needs of the users by approaching different perspectives. In the same time, by simplifying the systems and making them more efficient, the economical savings can rise to considerable amounts thanks to the reduce of energy consumption, products maintenance, between others.

At a system innovation level not only products, services and production systems are optimized, and new ways of satisfying consumption needs are found within existing institutional frameworks and infrastructures, but new infrastructures, spatial planning and incentive systems are developed and implemented that promote more sustainable lifestyles (Tukker, Tischner 2006).

6. CONCLUSIONS

The evolution in economy and lifestyles between other factors, have led to the creation of new working models in society. Due to these changes of behaviors, the priorities have mutated from owning to experiencing, therefore, designers now need not only to design products but furthermore intangibles that satisfy the needs of the end user.

Traditional offices are prevailing in the system while non-traditional models such as co-working spaces and hubs are appearing in the scene, bringing innovative spaces and services to different users with the main goal of creating community. Meanwhile, companies that work on the traditional model, are paying more attention to the user by creating spaces and services supporting the wellbeing of the workers.

Both, traditional and non-traditional models look on behalf to the sustainable workspace where three main aspects are taken in account: environmental, economic and socio-ethical (Vezzoli, Kohtala, Srinivasan, 2014). When applying these aspects to workspaces it becomes challenge for designers to create a system in which sustainability works in a holistic way.

From the socio-ethical point of view, workspaces need to be user based. This means they should be created with and for the user by co-designing with them. This product-service system design methodologies are developed in the early stages of design and are meant to understand the needs and desires of the users to achieve better results in the final workspace system. It is proved that in spaces where the user is more comfortable, and the environment is pleasant, the psychological and physical health of the users is better. In addition, by compromising and involving the workers in the design stages, the loyalty with the company, effectiveness and performance in work is higher.

Finally, to decrease the environmental impact it is necessary to research and comprehend the carbon footprint

that we leave with each material, finishing or lighting equipment that is included in a space. Therefore, as interior designers it is highly important to pay attention to the life cycle assessments to understand the impact that each of these pieces create through all the life cycle stages. These good practices help to take better decisions at the time of designing and will have a tremendous impact on the environment through time by having an efficient system with a low impact on the environment.

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